

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-01			
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:			
Contract Number EP-C-12-011		Contract Period 02/01/2012 To 09/30/2016 Base Option Period Number 4		Title of Work Assignment/SF Site Name Aerodynamic Trailer Component					
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Task 2					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance From 10/21/2015 To 09/30/2016			
Comments:									
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund </div>									
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.									
SFO (Max 2)									
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars) (Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1									
2									
3									
4									
5									
Authorized Work Assignment Ceiling									
Contract Period:		Cost/Fee:		LOE:					
02/01/2012 To 09/30/2016									
This Action:									
Total:									
Work Plan / Cost Estimate Approvals									
Contractor WP Dated:				Cost/Fee:		LOE:			
Cumulative Approved:				Cost/Fee:		LOE:			
Work Assignment Manager Name Prashanth Gururaja <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> (Signature) (Date) </div>						Branch/Mail Code: Phone Number 734-214-4771 FAX Number:			
Project Officer Name Greg Janssen <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> (Signature) (Date) </div>						Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name Jose Ortiz <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> (Signature) (Date) </div>						Branch/Mail Code: Phone Number: 513-487-2831 FAX Number: 513-487-2109			
Contracting Official Name Sandra Savage <div style="display: flex; justify-content: space-between; border-top: 1px solid black; margin-top: 10px;"> (Signature) (Date) </div>						Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

PERFORMANCE WORK STATEMENT

Contract / Work Assignment (WA): EP-C-12-011 / WA 4-01

Issuing Office: EPA Office of Transportation and Air Quality (OTAQ)
2000 Traverwood Dr.
Ann Arbor, Michigan 48105

Contractor: ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

Title: Aerodynamic Trailer Component Assessment and
Impact on the Green House Gas Emissions from
Heavy-Duty Combination Vehicles – Computational
Fluid Dynamics Simulation

Work Assignment Contract
Officer Representative (WA COR): Prashanth Gururaja
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I. BACKGROUND

On September 15, 2011, the United States Environmental Protection Agency (U.S. EPA) and the National Highway Traffic Safety Administration (NHTSA) published a final rulemaking establishing Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (HD GHG Phase 1). This program was the first of its kind focused on reducing greenhouse gas (GHG) emissions and improving the fuel efficiency of heavy-duty trucks and buses; it is projected to reduce CO₂ emissions by about 270 million metric tons and save about 530 million barrels of oil over the life of model year 2014 to 2018 vehicles.

As part of this rulemaking effort, an emphasis was placed on reducing the aerodynamic drag of heavy-duty trucks, specifically Class 7 and 8 combination tractors. Due to their large payloads, their high annual miles traveled, and their major role in national freight transport, Class 7 and 8 combination tractors and their engines contribute the largest portion of the total GHG emissions and fuel consumption (approximately 65 percent) of the heavy-duty sector. Based on empirical studies of Class 8 Tractors, a 1% improvement in aerodynamic drag equates to an approximately 0.5% improvement in fuel economy, and consequently equates to lower GHG emissions for HD Class 8 Tractor-Trailer combinations. Therefore, reducing the amount of aerodynamic drag on a Class 7/8 combination tractor-trailer reduces the GHG emissions, fuel consumption, and overall operating cost for a Class 7/8 combination tractor.

EPA is now developing a second phase of HD GHG regulations (HD GHG Phase 2). As done previously in HD GHG Phase 1, reduction in aerodynamic drag on a Class 7/8 combination tractor-trailer will be a major focus. Specifically, EPA is considering including HD trailers as part of the rule to further increase fuel economy and lower GHG emissions from Class 7/8 Tractor-Trailer combinations. This allows EPA to take a systems approach by looking at the tractor-trailer combination as an entire vehicle, not just focusing on the Class 7/8 engine and tractor separately from the trailer. The inclusion of trailers should provide additional benefits in HD GHG Phase 2 and build on the success and achievements in HD GHG Phase 1.

II. SCOPE

For HD GHG Phase 2, EPA seeks to evaluate the relationship between aerodynamic trailer devices and fuel consumption/CO₂ emissions. Determining the potential benefits of aftermarket or original equipment trailer aerodynamic devices (e.g., side skirts, boat tails, and front trailer treatments) is required to improve vehicle aerodynamic performance and reduce GHG emissions of HD Class 7/8 Tractor-Trailer combinations. In addition, determining the Reynolds Number (Re) sensitivity of tractor-trailer combinations and the impact of Re on the resulting drag polar or yaw curve, is important as well. As the agencies have proposed to allow vehicle manufacturers to use different methods, such as computation fluid dynamics (CFD) and wind tunnels, for certifying aerodynamic performance, it is important to learn about the differences between these methods' results.

To accomplish this, the contractor shall perform CFD simulations of a full-size, Class 8 Tractor-Trailer combination with and without aerodynamic trailer devices installed, individually and in combination, to quantify the aerodynamic drag change of aerodynamic trailer devices. Multiple CFD sources shall be used, as directed in the Tasks section, to obtain results using different software. All CFD simulations shall meet the proposed regulatory specifications in the heavy-duty GHG Phase 2 rule 40 CFR §1037.531, except where specified in this work assignment (e.g., Reynolds number).¹

III. TASKS

The contractor shall provide all required management, employee training, licensed personnel, permits, equipment, labor, materials, tools, personal protective equipment, and other items needed to accomplish each task. As novel and unexpected results may occur due to the nature of the work, the WA COR may provide technical direction via phone, email or in person followed-up with written technical direction during testing.

Task 1: CAD Files of Tractor Trucks, Trailers, Trailer Aerodynamic Devices

The CFD analysis shall be conducted on an OEM highway Class 8 sleeper and a Standard 53-foot trailer that meets 40 CFR §1037.501(g)(1). In addition, the trailer shall be analyzed in standard configuration and with aerodynamic trailer devices installed according to the test plans detailed in the attachments.

The contractor may be required to perform simulations of additional configurations of the tractor-trailer combination as provided in written technical direction from the WA COR.

For the purposes of this work assignment, the computer-aided drawing (CAD) files of the vehicles, trailers and tires will not become government property.

¹ CFD procedure in proposed Phase 2 GHG rule: <http://www.gpo.gov/fdsys/pkg/FR-2015-07-13/pdf/2015-15500.pdf> (p 40638). Changes from the Phase 1 regulations: <http://epa.gov/otaq/climate/documents/hd-ghg-regs.pdf> (p 189).

Task 1a. Heavy Duty Class 8 Sleeper Cab Tractor Truck

The contractor shall utilize a CAD file of one long-haul Class 8 2012 Freightliner Cascadia High Roof Sleeper Cab tractor equipped with an aerodynamic package for analysis under this work assignment. The truck shall be simulated with a Cummins ISX engine and proper flow through the cooling system. The Contractor shall ensure WA COR approval of the proposed truck/engine combination.

Task 1b. 53' Dry Box Van Trailer

The contractor shall utilize a CAD file of a 2008-09 Wabash 53' Dry Box Van Trailer for analysis under this work assignment. The trailer used for the analysis shall be designed to meet the requirements of 40 CFR §1037.501(g)(1), with the exception that aerodynamic features are permitted as described in Task 2. This includes the technical amendments made to this section in 2013 that updated the specifications for the trailer rear axle measurement.²

Task 1c. Aerodynamic Trailer Devices

The contractor shall utilize a CAD file of a Silver Eagle Aero Saber Trailer Skirt and an AT Dynamics Trailer Tail for analysis under this work assignment. If the contractor does not have access to a CAD file of a Silver Eagle Aero Saber skirt, the contractor shall notify the WA COR and may, instead, use a CAD file of a generic, HD Phase 2 skirt using the dimensions specified in the Notice of Proposed Rule Making (NPRM) 40 CFR §1037.501(g)(1)(v).³ If the contractor does not have access to a CAD file of an AT Dynamics Trailer Tail, the contractor shall notify the WA COR for technical direction on what specifications and dimensions to use for a generic trailer tail.

Task 2: CFD Simulation of a Class 8 Tractor-Trailer Combination

The contractor shall conduct CFD Analysis of a long haul Class 8 2012 Freightliner Cascadia High Roof Sleeper Cab tractor equipped with an aerodynamic package and a Cummins ISX engine, with a 2008-09 Wabash 53' Dry Box Van Trailer, with and without the trailer skirt and trailer tail from Task 1, as specified in the subtasks below. Additional detail on test scenario/case set-up for each sub-task may be provided by the WA COR. The contractor shall furnish results of this task to the WA COR as they become available. The contractor shall include a summary of all results from this task in the final report.

For all sub-tasks under this task, the contractor shall provide EPA with the raw data in CSV format for all valid results where convergence is reached during the CFD Analysis. The files shall include:

- Tractor
- Trailer configuration
- Yaw angle
- Reynolds number
- Drag area
- Coefficient of drag
- Frontal area
- Run time
- Flow passes

² The current version of the 40 CFR §1037.501 can be found here: http://www.ecfr.gov/cgi-bin/text-id?SID=8ebd49e1085a33774f9562b06e1edaa0&mc=true&node=se40.33.1037_1501&rgn=div8.

³ <http://www.gpo.gov/fdsys/pkg/FR-2015-07-13/pdf/2015-15500.pdf> (p 40624).

The contractor shall also provide a pressure contour map for each run assembled together into one PDF document.

Task 2a. Open Road Simulation

The contractor shall perform simulations, using two (2) or three (3) CFD sources, on an open-road environment with moving wheels and moving road with zero turbulence on a 2012 Freightliner Cascadia High Roof Sleeper Cab tractor with a Wabash 53' box trailer. The following conditions for analysis shall be used:

Reynolds Number	Yaw Angles [degrees]	Trailer Configuration	Simulation notes
5.1 million	-6,-3,-1, 0, +1, +3, +6, +9	Standard	65 mph (29.1 m/s)
		Skirt	
		Skirt + Tail	
4.3 million	-6, 0, +1, +3, +6, +9	Skirt	55 mph (24.6 m/s)
2.6 million	-6, 0, +1, +3, +6, +9	Skirt	50 m/s at 30% scale (15 m/s at full scale)
1.1 million	-6, 0, +1, +3, +6, +9	Standard	50 m/s at 12.5% scale (6.25 m/s at full scale)
		Skirt	

Additional details on the analysis set up will be provided in written technical direction by the WA COR to the contractor.

Task 2b. Reduced-Scale Wind Tunnel Simulation

The contractor shall perform simulations, using one (1) or two (2) of the CFD sources used in Task 2a, of a reduced-scale wind tunnel environment with moving wheels and moving road with zero turbulence using the same 2012 Freightliner Cascadia High Roof Sleeper Cab tractor with a Wabash 53' box trailer and Silver Eagle Aero Saber or HD Phase 2 trailer skirt and ATDynamics Trailer Tail installed. The following conditions for analysis shall be used:

Reynolds Number	Yaw Angles [degrees]	Trailer Configuration	Simulation notes
1.1 million	-6, 0, +1, +3, +6, +9	Standard	50 m/s at 12.5% scale (6.25 m/s at full scale)
		Skirt	

To maintain consistency in the results, the contractor shall use as the basis for the simulations in the reduced-scale wind tunnel, the open-jet, moving floor wind tunnel facility at the Auto Research Center in Indianapolis, Indiana (ARC-Indy). Additional details on the analysis set up will be provided in written technical direction by the WA COR to the contractor.

Task 2c. Turbulence Intensity Simulation

The contractor shall perform simulations, using one (1) or two (2) of the CFD sources used in Task 2a, of an open-road environment with moving wheels and moving road with 3% turbulence intensity on a 2012 Freightliner Cascadia High Roof Sleeper Cab tractor with a Wabash 53' box trailer and Silver Eagle Aero Saber or HD Phase 2 trailer skirt installed. The following conditions for analysis shall be used:

Reynolds Number	Yaw Angles [degrees]	Trailer Configuration	Turbulence Intensity
5.1 million	-6, 0, +1, +3, +6, +9	Skirt	3%

IV. DELIVERABLES

1. Kick-off Meeting

Within one week after the WA is issued, but prior to the contractor submitting a Work Plan, the contractor shall discuss this work assignment with the WA COR to ensure a common understanding of the requirements, expectations, and ultimate end products.

2. Develop Quality Assurance Project Plan

The contractor shall submit a draft QAPP to the WA COR within 15 days of Work Plan approval. The QAPP shall detail data collection and analysis tasks and procedures for this work assignment. The WA COR shall review and comment on the draft QAPP. The contractor shall incorporate recommended changes and suggestions received from the WA COR and shall submit a final QAPP within 15 days after receipt of EPA comments. Guidance can be found at: QAPP for use of existing data: <http://www.epa.gov/quality/qs-docs/found-data-qapp-rqts.pdf>; Assessment Factors for relevance, applicability, utility of existing data: <http://www.epa.gov/spc/pdfs/assess2.pdf>; and EPA Requirements for QAPPs: <http://www.epa.gov/quality/qs-docs/r5-final.pdf>.

The final QAPP shall cover all aspects of this test program as outlined on the EPA quality website. The QAPP shall have an appendix containing all applicable standard operating procedures (SOPs). The contractor shall adhere to all applicable SOPs and the QA procedures recommended therein. The contractor shall notify the WA COR immediately if they encounter any equipment failures that cannot be remedied, problems that may impact the quality or on-time receipt of deliverables, or unavailability of items required for this work assignment.

3. Regular Progress Reports

The contractor shall provide the WA COR with regular status reports via telephone conference or email during the period of performance. The frequency of the progress report can be adjusted as weekly or bi-weekly depending on the progress of the program. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the WA COR concerning the scope of the solution.

4. Technical Reports

The contractor shall provide the WA COR with a brief Technical Report upon completion of each task. Depending on the complexity of the subject matter and as directed via written technical direction by the WA COR, these reports shall be in the form of either a presentation or a formal written document. Written products shall be delivered in formats specified by the WA COR (e.g., Word, Excel).

5. Data

The contractor shall provide the WA COR with simulation results within 5 days of completion of the contractor's quality control review and approval for such data. The contractor shall provide to the WA COR simulation results from each task within 14 days of completion of the simulation.

6. Draft and Final Reports

The contractor shall provide to the WA COR a Draft Final Report and data set summarizing the results of all tasks within 30 days of completion of the laboratory and modeling work contained in this work assignment. The contractor shall deliver the Final Report within 15 days of receipt of comments from the WA COR. All reports and associated materials (e.g., data sets) shall be provided in formats specified by the WA COR.

Schedule of Deliverables

Steps	Completion Date
Kick-off Meeting (as necessary based on direction from the WA COR)	Within 1 week of receipt of work assignment
QAPP submission	Within 15 days of receipt of Work Plan approval
Final QAPP	Within 15 days of receiving EPA comments
Complete Tasks 1 and 2	Before December 15, 2015
Draft Final Report	Within 30 days of completion of all tasks
Final Report	Within 15 days of receipt of EPA comments on Draft Final Report

NON-DISCLOSURE AGREEMENT

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the contractor to any other source without specific approval by U.S. EPA.

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-05				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2016 Base Option Period Number 4			Title of Work Assignment/SF Site Name GHG Transportation Inventory				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 7a					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance From 10/01/2015 To 09/30/2016				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO (Max 2) <input type="checkbox"/>										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012 To 09/30/2016										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:				Cost/Fee:			LOE:			
Cumulative Approved:				Cost/Fee:			LOE:			
Work Assignment Manager Name Amy Bunker <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number 734-214-4160 FAX Number:			
Project Officer Name Greg Janssen <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name Jose Ortiz <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2831 FAX Number: 513-487-2109			
Contracting Official Name Sandra Savage <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

PERFORMANCE WORK STATEMENT

EPA Contract: EP-C-12-011

Work Assignment (WA): 4-05

Issuing Office: US Environmental Protection Agency
Office of Transportation and Air Quality (OTAQ)
2000 Traverwood Dr.
Ann Arbor, Michigan 48105

Contractor: ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

Statement of Work: GHG Transportation Inventory Development

Period of Performance: October 1, 2015 – September 30, 2016

Work Assignment Contracting Officer Representative (WA COR):
Amy Bunker
734-214-4160
bunker.amy@epa.gov

Alternate WA COR: Kristin Kenausis
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Kenasis.Kristin@epa.gov

BACKGROUND

The transportation sector is responsible for roughly 30 percent of greenhouse gas (GHG) emissions in the U.S., as well as the production of smog precursors, carbon monoxide (CO) and air toxics. Other impacts from transportation include noise and ecosystem disturbance. These effects are acknowledged through national legislation and other commitments, including:

- National Environmental Protection Act of 1969 (NEPA)
- Clean Air Act (CAA) Amendments of 1990
- Intermodal Surface Transportation Act of 1991 (ISTEA)
- Transportation Equity Act for the 21st Century (TEA-21)
- Climate Change Action Plan of 1993 (CCAP) and
- 1993 United Nations Framework Convention on Climate Change (UNFCCC).

EPA supports a range of analytic functions to demonstrate the environmental impacts of transportation. The U.S., with lead responsibility by EPA, is required by the UNFCCC to report to the United Nations all U.S. emissions and sinks of GHGs. By mutual agreement with the Office of Atmospheric Programs (OAP), the Office of Transportation and Air Quality (OTAQ) has assumed responsibility for preparing estimates of GHG emissions for the transportation sector. Within OTAQ, the Transportation and Climate Division (TCD) manages this analysis. TCD also supports EPA programs by examining the intersection of transportation policy, travel demand, vehicle engine technologies and energy consumption. Finally, TCD assists OTAQ and EPA in providing data and analysis to address the information requests of Congress, the Executive Branch, and the public.

SCOPE

TCD's analytic work addresses the environmental impacts of transportation programs, policies and investments at all levels of government. This effort enhances the technical capacity of stakeholders in the fields of climate change analysis, air quality management, and transportation and urban planning.

TCD's analysis of transportation and climate change includes the development of an emissions inventory that identifies and quantifies the primary anthropogenic sources and sinks of U.S. GHG emissions from transportation sources. The GHG transportation inventory must contain: (1) a comprehensive and detailed methodology for estimating sources and sinks of anthropogenic GHG emissions at levels sufficiently detailed to support policy decisions; and (2) represent a common and consistent source of information enabling OTAQ to compare the relative contribution of different GHG emission sources to climate change. The ability to estimate emissions systematically and consistently is a prerequisite for evaluating the cost-effectiveness and feasibility of GHG mitigation strategies.

TASKS

Task 1: 2014 Public Review and Final Reports

The Contractor shall prepare the annual GHG emission inventory from the transportation sector for the public review and final versions of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014 document ("2014 Public Review and Final reports"). The inventory shall include estimates of carbon dioxide (CO₂), methane (CH₄), Nitrogen Dioxide (N₂O) and hydrofluorocarbons (HFC) emissions from all mobile sources, including highway vehicles, aircraft, rail, watercraft, and non-road mobile sources. The inventory shall also include emissions of the following criteria pollutants: CO, NO_x, VOCs, and sulfur dioxide (SO₂); estimates of these gases are to be obtained from the Office of Air Quality Planning and Standards (OAQPS).

The Contractor shall build upon the work already conducted under Task 5 from WA 3-05 of the subject contract (EP-C-12-011), improving on the estimation and documentation associated with both annual emission estimates and emission trends for the transportation inventory as provided in written technical direction by the WA COR. This task shall include all additional work necessary to complete the Public Review and Final reports, including addressing expert review comments and public review comments. This task shall also include performance of QA/QC and uncertainty analyses.

The Contractor shall report transportation GHG data in accordance with the schedule and formats necessary to complete the 2014 Public Review and Final reports as defined through written technical direction by the WA COR. The Contractor shall receive approval from the WA COR prior to submitting any transportation-related data to OAP.

The WA COR will provide the Contractor with the guidance regarding uncertainty analysis; QA/QC activities; and requirements for documentation, spreadsheet management, annexes, work breakdown structure (WBS), and report write-up.

Task 2: Novel Inventory Improvements

The GHG Inventory shall be updated and improved to reflect new datasets, new methodologies, and new tools that better capture and describe the transportation emissions inventory. Under this task, the Contractor shall provide analysis, research, and reports that support improvements to the data, methodology, tracking, and error-checking that are not a part of routine improvements conducted under Tasks 1 and 6. During the performance of this

task, the Contractor shall provide an informal estimated level of effort for multiple improvements at the technical direction of the WA COR. As specific needs may evolve within the period of the contract, the WA COR will provide written technical direction for each report, prior to the Contractor commencing work.

Task 3: Novel Inventory Improvements – Documentation Memos

Task 3(a): Finalize Documentation Memos

The Contractor shall finalize the documentation improvement memos ("memos 1, 2, and 3") that were created under Task 3 in WA 3-05 of the subject contract (EP-C-12-011). This entails responding to outstanding questions from the WA COR and making minor updates to the documentation memos for the 1990-2013 Inventory.

Task 3b: Update Documentation Memos for 1990-2014 Inventory

After the final 1990-2014 Inventory is complete, the contractor shall make additional minor updates to memos 1, 2, and 3 to reflect the Inventory data for the final version of the 1990-2014 inventory.

Task 3c: Novel Inventory Improvements – Additional Documentation

As additional specific needs may evolve within the scope of work and the period of performance, the contractor shall provide an additional documentation memo upon receiving written technical direction from the WA COR.

Task 4: Inputs to Fast Facts

In conjunction with preparation of the final report in Task 1, the Contractor shall prepare data for a summary report, "2014 Fast Facts", to be released publicly which summarizes emissions from transportation sector. The data for the "2014 Fast Facts" shall be prepared in a similar fashion to the data provided under WA 3-05 for the "2013 Fast Facts" (called the 2013 Fast Facts document under WA 3-05). The summary data shall convey the highlights from the current year's inventory in sufficient detail to be used by policymakers in OTAQ, while also be understood by the general public.

Task 5: Educational Materials

The Contractor shall prepare data to support educational materials as needed, per technical direction from the WA COR. These materials may include up to three presentations targeted to EPA staff which explain the process, timeline, data sources, and methodology for completing the annual Inventory. In addition to preparing these materials, the Contractor may be asked to present them to EPA staff.

Task 6: 2015 Expert Review Report

The Contractor shall prepare a draft of the 1990-2015 GHG emission inventory from the transportation sector for the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015* report ("2015 Expert Review report").

The Contractor shall build upon the work conducted under Task 1, improving on the estimation and documentation associated with both annual emission estimates and emission trends for the transportation inventory as directed by the WA COR. The inventory shall include estimates of carbon dioxide (CO₂), methane (CH₄), nitrogen dioxide (N₂O) and hydrofluorocarbons (HFC) emissions from all mobile sources, including highway vehicles, aircraft, rail, watercraft, and non-road mobile sources. The inventory shall also include emissions of the following criteria pollutants: CO, NO_x, VOCs, and sulfur dioxide (SO₂); estimates of these gases are to be obtained from the Office of Air Quality Planning and Standards (OAQPS).

This task shall include performance of Quality Assurance and Quality Control (QA/QC), but not uncertainty analyses.

QUALITY ASSURANCE (QA) REQUIREMENTS

The Contractor shall submit a written Quality Assurance (QA) Project Plan that describes the quality assurance procedures, quality control specifications, and other technical activities that must be implemented to ensure that the results of the project or task to be performed. Alternatively, the contractor can submit a Quality Assurance Supplement to their Quality Management Plan that includes all the required information for a QA Project Plan.

DOCUMENTATION

The Contractor shall fully substantiate and document all of its work. No work shall be duplicated under this contract. In order to avoid duplication of effort, the Contractor shall always investigate existing literature and consult with the EPA WA COR about any information the agency may have or know about prior to undertaking any market research activities. Reports submitted by the Contractor that contain recommendations to EPA shall explain and rank policy or action alternatives, describe the procedure used to arrive at recommendations, summarize the substance of deliberations, report any dissenting views, list the sources used, and make clear the methods and considerations upon which the recommendations are based.

DISTRIBUTION AND FORMAT OF DELIVERABLES

The Contractor shall deliver all work assignment deliverables, including status reports and interim products, in an appropriate electronic format (e.g., Microsoft Word, Excel, and Acrobat). This applies to all tasks under this work assignment unless otherwise specified in written technical direction by the WA COR.

DELIVERABLES

The schedule for deliverables may be adjusted through written technical direction from the WA COR.

Task	Deliverable	Schedule
	<u>Kick-off Meeting</u> : The WA COR and Contractor shall meet to discuss the tasks within the workplan.	Within one week of approval of workplan.
	<u>Biweekly Progress Reports</u> : In addition to the monthly progress reports, the WA COR and the Contractor shall contact each other to ensure that adequate progress is being made on all tasks.	At least once every other week.
	<u>Responding to EPA Questions</u> : The Contractor shall respond to EPA technical questions related to the tasks via email and phone.	As needed, per technical direction from WA COR.
1	<u>2014 Public Review report spreadsheets</u> : The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the 2014 Public Review report.	January 12, 2016

1	<u>2014 Public Review report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2014 Public Review report.	January 26, 2016
1	<u>2014 Final Report spreadsheets:</u> The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the Final report.	March 23, 2016
1	<u>2014 Final Report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2013 Final report.	March 30, 2016
2	<u>Inventory Improvements Meeting and Memo:</u> The WA COR and Contractor shall meet to discuss initiating improvements for next year's inventory. In preparation for this meeting, the Contractor shall update the Inventory Improvements Memo completed under WA 3-05 with additional improvements identified during this year's inventory preparation and estimate the associated level of effort as well as the relative utility for inventory users.	After completion of Task 1, per technical direction from WA COR.
2	<u>Novel Inventory Improvements:</u> The Contractor shall provide an estimated level of effort for additional improvements not initially identified in the Inventory Improvements Memo.	As needed, per technical direction from WA COR.
3a	<u>Documentation Memos 1-3 are finalized for 1990-2013</u>	November 30, 2015
3b	<u>Minor updates to documentation Memos 1-3 to reflect 1990-2014 Inventory data and methodology.</u>	April 30, 2016
3c	<u>Additional documentation Memo</u>	As needed, per technical direction from WA COR.
4	<u>Input to Fast Facts and Review</u>	After completion of Task 2, per technical direction from WA COR.
5	<u>Input to Other Educational Materials</u>	As needed, per technical direction from WA COR.
6	<u>2015 Expert Review report spreadsheets:</u> The Contractor shall provide the WA COR with draft spreadsheets and any supplemental analyses conducted in support of the transportation component of the 2015 Expert Review report.	September 11, 2016
6	<u>2015 Expert Review report text:</u> The Contractor shall provide the WA COR with draft documents and text sections in support of the transportation component of the 2015 Expert Review report.	September 25, 2016

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-08	
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:	
Contract Number EP-C-12-011		Contract Period 02/01/2012 To 09/30/2016		Title of Work Assignment/SF Site Name			
		Base Option Period Number 4		Travel Efficiency Assessment			
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Task 7a			
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval				Period of Performance From 10/05/2015 To 09/30/2016			
Comments:							
<input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund							
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.							
SFO <input type="checkbox"/> (Max 2)							
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars) (Cents) Site/Project (Max 8) Cost Org/Code (Max 7)
1							
2							
3							
4							
5							
Authorized Work Assignment Ceiling							
Contract Period: 02/01/2012 To 09/30/2016		Cost/Fee:		LOE:			
This Action:							
Total:							
Work Plan / Cost Estimate Approvals							
Contractor WP Dated:		Cost/Fee:		LOE:			
Cumulative Approved:		Cost/Fee:		LOE:			
Work Assignment Manager Name Patty Klavon						Branch/Mail Code:	
_____ (Signature) (Date)						Phone Number 734-214-4476	
						FAX Number:	
Project Officer Name Greg Janssen						Branch/Mail Code:	
_____ (Signature) (Date)						Phone Number: 734-214-4285	
						FAX Number: 734-214-4821	
Other Agency Official Name Jose Ortiz						Branch/Mail Code:	
_____ (Signature) (Date)						Phone Number: 513-487-2831	
						FAX Number: 513-487-2109	
Contracting Official Name Sandra Savage						Branch/Mail Code:	
_____ (Signature) (Date)						Phone Number: 513-487-2046	
						FAX Number:	

PERFORMANCE WORK STATEMENT

Contract / Work Assignment (WA): EP-C-12-011 / 4-08

Title: Travel Efficiency Assessment Methodology Case Studies

Contractor: ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

**Work Assignment Contracting
Officer Representative (WA COR):** Patty Klavon
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Period of Performance: Initiation to September 30, 2016

This work assignment is a follow-on to complete work begun under Work Assignment 3-08. This is a continuation of effort, the contractor shall not duplicate any work previously performed.

BACKGROUND

The Transportation and Climate Division (TCD) of the EPA's Office of Transportation and Air Quality (OTAQ) provides analysis, guidance and technical assistance of transportation policy and program effects on mobile source emissions and air quality to Federal, State, and local agencies and governments. These stakeholders are increasingly interested in evaluating the effectiveness of travel efficiency (TE) and other related strategies for reducing emissions of criteria pollutants and their precursors as well as greenhouse gases (GHG).

From 2011 through the present, TCD has published a series of reports describing a peer reviewed methodology, the "Travel Efficiency Assessment Method" ("TEAM") for evaluating the emission benefits of travel efficiency strategies¹ and the subsequent analyses and findings from case studies documenting the application of TEAM in Boston, Kansas City, and Tucson to assess the potential regional emission reductions from travel efficiency strategies.

In January, 2015 the EPA initiated three new TEAM case studies in St. Louis, Atlanta, and Orlando under WA 3-08 Contract EP-C-12-011 ("WA 3-08"). These case studies offer an opportunity for the EPA to further assess travel efficiency strategies, to demonstrate the capabilities of the TEAM

¹ TEAM is a methodology developed by EPA, which combines the use of a transportation sketch planning tool that estimates changes in travel activity with estimates of emission rates from MOVES, to produce emissions estimates from travel activity. Changes in travel activity, estimated for representative urban areas of the country, are applied to similar urban areas and then scaled up to estimate changes travel activity for the entire nation. Emissions estimated by MOVES are combined with the estimated change in travel activity to estimate changes in emissions.

approach with a focus on the land use component, and to evaluate its usefulness at the regional scale.

PURPOSE

The contractor shall complete the work started under WA 3-08 to provide technical assistance for GHG planning and TE assessment case studies based upon TEAM.

Under WA 3-08, the contractor secured an agreement from the transportation planning agencies representing St. Louis, Atlanta, and Orlando to participate in the TE assessment case studies, developed a plan to coordinate the stakeholder process, and prepared data needed to perform the analyses. Under this follow-on WA, the contractor shall complete preparing the data, perform the analyses, document the process of working with the agencies and the technical results in draft and final memoranda, and create a draft and final report.

This work assignment also includes an optional task (Task 5). If the optional Task 5 is implemented, the Contractor shall update the modeling of the scenarios analyzed under WA 1-08 Contract EP-C-12-011 ("WA 1-08") and prepare a memorandum describing the results. The Contractor shall provide a cost estimate for this task separate from the Contractor's cost estimate for Tasks 1-4.

TASKS

Task 1: Evaluation of Transportation Strategies Using the Team Method

This task builds upon work from Task 3: Evaluation of Transportation Strategies Using the TEAM Method, from WA 3-08.

Subtask 1(a).

The Contractor shall coordinate with the EPA, the selected agency, and stakeholders to establish the modeling baseline and agree on up to six (6) transportation strategy scenarios to be analyzed as part of each case study.² One scenario shall be "business as usual" to reflect a future year base case against which the other scenarios can be compared. This "business as usual" scenario shall reflect the land use changes and growth in transportation that the MPO is currently anticipating for the chosen analysis year. The other scenarios could potentially include any transportation control measure or other VMT-reducing strategy, or grouping of strategies, that are not already included in the "business as usual" scenario that TRIMMS is capable of analyzing. Such strategies could include:

- Travel demand management measures
- Land use strategies
- Transit fare discounts and service improvements
- Road pricing measures (including parking charges and mileage-based fees)
- Any combination of the above strategies.

The Contractor shall coordinate with EPA, the selected agency, and any stakeholders, on how to best specify each scenario to be analyzed, including the appropriate model input and output values. The Contractor shall work with the selected agency and stakeholders to identify travel data and any other data necessary to run the TRIMMS and MOVES models for the chosen scenarios. The Contractor shall provide a draft copy of all proposed model inputs to the WA COR, the selected agency, and stakeholders. These inputs will be reviewed by the EPA, the selected agency, and stakeholders and revised per their review. Modeling and analysis shall not begin until the EPA has determined that sufficient agreement has been reached among the

² A maximum of 18 transportation strategy scenarios (six for each of the three selected agencies) could potentially be analyzed under this subtask.

EPA, the selected agency, and any stakeholders on the scenarios to be modeled and the modeling specifications. The Contractor shall receive written technical direction from the WA COR approving the remaining final inputs prior to the Contractor starting any modeling.

Subtask 1(b).

The Contractor shall model and analyze each strategy scenario using, to the extent practical, the TEAM methodology described and used in Contract EP-C-06-094, Work Assignment 2-01 (note that the geographic scope for modeling and analysis shall not be performed at the national scale, as was done in that work assignment). The Contractor shall use TRIMMS to perform the transportation sketch modeling for TE strategies other than land use. For land use, the Contractor shall use a method as provided in written technical direction by the WA COR based on the memo written under Task 2. The MOVES emissions model shall be run at the county scale using inputs based on local data specific to each participating area, to the extent practicable, and adhere to the latest EPA guidance for estimating on-road greenhouse gas emissions.³ The Contractor shall report any recommended deviations from the aforementioned methodology and guidance to the EPA as soon as they are identified; any such deviations shall only be followed upon receipt of written technical direction from the WA COR.

Subtask 1(c).

Following completion of the remaining TRIMMS and MOVES modeling for each selected agency, the Contractor shall submit draft technical results to the WA COR using the same tabular format used to publish the results in the report: *Potential Changes in Emissions Due to Improvements in Travel Efficiency*. These results shall include estimates for Volatile Organic Compounds (VOC), Nitrogen Oxides (NOx), Fine Particulate Matter (PM_{2.5}), and Carbon Dioxide (CO₂).

Within 14 days of review and approval of the technical results described above, the Contractor shall submit draft memoranda (one for each selected agency) describing and documenting the modeling assumptions, strategies assessed, and results. In addition to the draft memoranda, the Contractor shall submit the MOVES RunSpec file for each scenario analyzed and the MOVES input and output databases associated with each MOVES run. The Contractor shall name these three items similarly so that it is clear which files and databases are associated with one another.⁴

The EPA, selected agencies, and any stakeholders will review and comment on the draft memoranda and MOVES files/databases. The Contractor shall incorporate any agency and EPA comments in a final memo within 14 days of receiving comments.

Deliverables

1. Remaining proposed TRIMMS and MOVES inputs for each case study scenario
2. Remaining final TRIMMS and MOVES inputs for each case study scenario
3. Remaining MOVES RunSpec file, input database, and output database for each case study scenario
4. Results in tabular format for each case study scenario
5. Draft results memoranda with assumptions, strategies and results for each selected agency
6. Final results memoranda with assumptions, strategies and results for each selected agency

³ On the date of this Performance Work Statement, the latest available guidance, *Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption – Final, November 2012*, could be found at <http://www.epa.gov/otaq/stateresources/ghgtravel.htm>.

⁴ For example, the MOVES RunSpec name could be “areaname_scenario1.mrs,” the input database “areaname_scenario1_in,” and the output database “areaname_scenario1_out.”

Task 2: Review of Existing Greenhouse Gas Analyses

As part of the case study of each selected agency, the Contractor shall prepare a brief memo reviewing and describing any regional-scale greenhouse gas analyses the selected agency (or any associated stakeholder) may have recently completed in the area. The Contractor shall document any differences between the methodology used in any such analyses and the method described by TEAM. This task need not necessarily include a comparison of specific quantitative results between any existing greenhouse gas analyses and the TEAM results in cases where the methodologies are not comparable, but at a minimum, shall include a qualitative evaluation of the results and a discussion about how the different methodologies and source data and assumptions could influence the results. The Contractor shall include the results of this task in the appropriate case study report (see Task 3).

Deliverables

7. Draft memo identifying other regional-scale greenhouse gas analyses and comparing methodologies for each selected agency
8. Final memo identifying other regional-scale greenhouse gas analyses and comparing methodologies for each selected agency

Task 3: Case Study Reports

The Contractor shall incorporate the results of Tasks 1-4 into a draft report. The memoranda for the previous tasks shall form the basis of the draft report, which shall include, at a minimum:

- An overall summary and general conclusions, considering the results of all three case studies;
- Self-contained sections containing the results of each selected agency's case study, including the stakeholder process involved, the strategies evaluated in each case study, the assumptions and methodologies used in the strategy evaluations, evaluation of the adherence or deviation from TRIMMS and MOVES guidance, and any challenges (technical or otherwise) encountered and how they were addressed; and
- Information, including any lessons learned or best practice, determined to be useful to other state or local areas wishing to perform its own analysis of GHG or criteria emissions reductions for various travel efficiency scenarios.

The EPA will review the initial version of the draft report. After incorporating any EPA comments received from the WA COR, the Contractor shall send the draft report to the selected agencies (and associated stakeholders, as needed) for their review and comment. After receiving comments from the selected agencies and any stakeholders, the Contractor shall arrange for and facilitate any discussions between the EPA, selected agencies, and any stakeholders, via conference call or web-based meeting, to develop consensus on the final text.

After receiving final comments on the draft report from the EPA, selected agencies, and any stakeholders, the Contractor shall develop a final report for this task. The final report shall respond to any comments received on the draft. The Contractor shall submit a draft of this final report to the WA COR for review and comment. Within 14 days of receiving comments, the Contractor shall submit a final copy incorporating the comments received.

Deliverables

9. Draft final report
10. Final report

Task 4: Review of Literature Cost and Cost Effectiveness of Implementing Travel Efficiency Strategies

The Contractor shall conduct a thorough review of the literature concerning the cost and/or cost effectiveness of implementing TE strategies including:

- Travel demand management measures
- Land use strategies
- Transit fare discounts and service improvements
- Road pricing measures (including parking charges and mileage-based fees)
- Alternate fuel vehicles
- Emerging strategies, such as eco-driving, pay-as-you-go insurance, operational efficiencies from using smart phone technology, and increases in vehicle renting rather than ownership.

The review shall focus on information published in the last 10 years. Sources may include, but are not limited to: TRB reports; papers in transportation-related journals; and studies prepared by or for universities, state departments of transportation, metropolitan planning organizations, and other similar state or local agencies. For the purpose of this task, cost effectiveness is broadly defined. The contractor shall include literature that addresses cost effectiveness on a dollar per ton reduced basis for one or more pollutants (e.g., PM2.5, NOx, VOCs and CO2) as well as literature that addresses broader costs and benefits to society such as literature on the cost of sprawl. The Contractor shall provide the EPA with a draft memo that summarizes the findings of the review. This shall include for each item found through the review:

- A summary of the information on cost or cost effectiveness.
- A brief description of the methodology and data sources used by the authors and major assumptions that were made.
- A complete reference to the study or journal article.

The EPA will review and comment on the draft memorandum. The Contractor shall incorporate EPA comments in a final memo within 14 days of receiving comments.

Deliverables:

11. Draft memo on the results of the literature review as described above
12. Final memo on the results of the literature review as described above

Task 5 (Optional): Update 2013 Case Studies

Upon receipt of written technical direction from the WA COR, and CO approval if necessary, the Contractor shall update the modeling of the scenarios chosen by the three areas for the 2013 case studies: Pima Association of Governments, Massachusetts DOT, and Mid-America Regional Council under WA 1-08 Contract EP-C-12-011 ("WA 1-08"). The Contractor shall update the land use component of the TRIMMS analysis according to the approach used in Task 3, subtask b, and update the emissions modeling with MOVES2014. The Contractor shall present these results in a draft memo to the WA COR for review and comment. The Contractor shall revise the memo and submit a final copy within 14 days of receipt of comments.

Deliverables

13. Draft memo describing the update to the 2013 case studies and the results
14. Final memo describing the update to the 2013 case studies and the results

CONSOLIDATED DELIVERABLES AND SCHEDULE

Note: Due dates are notional and subject to change based on Contractor's work plan and subsequent discussions and written agreement between WA COR and the Contractor.

<u>Task No.</u>	<u>Deliverable(s)</u>	<u>Schedule/Due Date</u>
	Quality Assurance Project Plan	10 days after work plan approval
Task 1		
1	Remaining proposed TRIMMS and MOVES modeling inputs	10 days from initiation
2	Remaining final TRIMMS and MOVES modeling inputs	20 days from initiation
3	Remaining MOVES RunSpecs and databases for each case study scenario	30 days from initiation
4	Tabular results for each case study scenario	40 days from initiation
5	Draft modeling results memoranda for each selected agency	55 days from initiation
6	Final modeling results memoranda for each selected agency	65 days from initiation
Task 2		
7	Draft GHG comparison memo	55 days from initiation
8	Final GHG comparison memo	65 days from initiation
Task 3		
9	Draft final report	75 days from initiation
10	Final report	90 days from initiation
Task 4		
11	Draft cost effectiveness literature review memo	75 days from initiation
12	Final cost effectiveness literature review memo	90 days from initiation
Optional Task 5		
13	Draft memo describing the update to the 2013 case studies and the results	55 days from initiation
14	Final memo describing the update to the 2013 case studies and the results	70 days from initiation

DISTRIBUTION AND FORMAT OF DELIVERABLES

The Contractor shall deliver all work assignment deliverables, including status reports and interim products, in an appropriate electronic format (e.g., Microsoft Word, Excel, and Acrobat). MOVES input and output databases can be submitted as MySQL databases. This applies to all tasks under this work assignment unless otherwise specified in written technical direction by the EPA WA COR.

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-08				
						<input type="checkbox"/> Other <input checked="" type="checkbox"/> Amendment Number: 000001				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2016 Base Option Period Number 4			Title of Work Assignment/SF Site Name Travel Efficiency Assessment				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW 7a					
Purpose: <input type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input checked="" type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance From 10/05/2015 To 09/30/2016				
Comments: The purpose of this amendment is to update the Work Assignment Contracting Officer Representative (WA COR). This is an administrative amendment, no further action from the contractor is required.										
<input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO <input type="checkbox"/> (Max 2)										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
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5										
Authorized Work Assignment Ceiling										
Contract Period: Cost/Fee: LOE: 02/01/2012 To 09/30/2016										
This Action: 										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated: Cost/Fee LOE:										
Cumulative Approved: Cost/Fee LOE:										
Work Assignment Manager Name Mark Simons <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4420 FAX Number:			
Project Officer Name Greg Janssen <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name Jose Ortiz <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 202-564-6762 FAX Number:			
Contracting Official Name Sandra Savage <div style="display: flex; justify-content: space-between;"> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between;"> <div>(Signature)</div> <div>(Date)</div> </div>							Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

PERFORMANCE WORK STATEMENT

Contract / Work Assignment (WA): EP-C-12-011 / 4-08 Amendment 1

Title: Travel Efficiency Assessment Methodology Case Studies

Contractor: ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

**Work Assignment Contracting
Officer Representative (WA COR):** Mark E. Simons
2565 Plymouth Road
Ann Arbor, MI 48105
Phone: 734-214-4420
Fax: 734-214-4052
Email: simons.mark@epa.gov

The purpose of Amendment 1 is to update the WA COR to Mark E. Simons. This is an administrative amendment, no further action from the contractor is required.

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-11			
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:			
Contract Number EP-C-12-011		Contract Period 02/01/2012 To 09/30/2016 Base Option Period Number 4		Title of Work Assignment/SF Site Name Analysis of Ambient Air Lead					
Contractor ICF INCORPORATED, L.L.C.				Specify Section and paragraph of Contract SOW Task 7a					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance From 10/15/2015 To 09/30/2016			
Comments:									
<input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund									
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.									
SFO <input type="checkbox"/> (Max 2)									
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars) (Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1									
2									
3									
4									
5									
Authorized Work Assignment Ceiling									
Contract Period:		Cost/Fee:		LOE:					
02/01/2012 To 09/30/2016									
This Action:									
Total:									
Work Plan / Cost Estimate Approvals									
Contractor WP Dated:		Cost/Fee:		LOE:					
Cumulative Approved:		Cost/Fee:		LOE:					
Work Assignment Manager Name Christy Parsons <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number 734-214-4243 FAX Number:			
Project Officer Name Greg Janssen <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number: 734-214-4285 FAX Number: 734-214-4821			
Other Agency Official Name Christy Parsons <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number: 734-214-4243 FAX Number:			
Contracting Official Name Sandra Savage <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code: Phone Number: 513-487-2046 FAX Number:			

PERFORMANCE WORK STATEMENT

Contract / Work Assignment: EP-C-12-011 / WA 4-11

Title: Additional Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network and Nationwide Aircraft Fleet

Contractor: ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

Work Assignment Contracting Officer Representative (WA COR):
Christy Parsons
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Alternate WA COR: Meredith Pedde
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Email: pedde.meredith@epa.gov

Period of Performance: Issue Date – September 30, 2016

I. Background

Tetraethyl lead is used as an additive in aviation fuel for most piston-engine powered aircraft. Lead (Pb) emissions from the use of leaded aviation gasoline (avgas) accounts for over half of the air emission inventory for lead. EPA has been petitioned to conduct an investigation to evaluate whether aircraft lead emissions cause or contribute to air pollution that may reasonably be anticipated to endanger the public health or welfare.

II. Purpose

This work assignment supports EPA's continued investigation and study of lead emitted by piston-engine aircraft and potential impacts on air quality. This work assignment includes the use of data collected by the contractor in three previous work assignments: Work Assignment (WA)0-10 under EPA contract EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors"), WA 3-66 under EPA contract EP-C-09-009 ("Ambient Lead Concentrations from Piston-engine Aircraft"), and WA 3-11 under EP-C-12-011 ("Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet"). The contractor shall not duplicate any work previously performed.

The contractor shall perform the following services under this work assignment: Task 1, conduct quantitative analyses of the relationship between monitored ambient lead concentrations at airports and variables that impact ambient air lead concentrations (e.g., concentration of lead in avgas, number of aircraft operations) and Task 2, compare the composition of the piston aircraft fleet at the Reid-Hillview airport (RHV) with the national piston aircraft fleet. Each of these tasks is described in detail below, along with deliverables associated with each task.

III. Statement of Work

A. Scope

The purpose of this work assignment is to provide assistance to EPA/OTAQ/ASD in evaluating whether aircraft lead emissions cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. Secondary objectives are included and described in the specific tasks enumerated below.

B. Specific Requirements

The Contractor shall provide periodic updates by phone or email with the WA COR on at least a bi-weekly basis, indicating progress, questions, or problems with the project. Any questions or requests received from the WA COR by phone or email shall receive a response within one business day.

The QAPPs provided to EPA under WA 0-10 and 1-10 under EP-C-12-011, WA 3-66 under EP-C-09-009, and WA 3-11 under EP-C-12-011 may be used as a starting point to satisfy the QAPP requirements for this work assignment. The contractor shall update this QAPP to account for any new tasks included in this work assignment. The contractor shall not commence work involving environmental generation data or use until the EPA WA COR has approved the QAPP.

C. Tasks

Task 1: Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network.

In a previous work assignment (3-11), the contractor began work to provide EPA with quantitative analyses of the relationship between monitored concentrations of lead in ambient air at airports and the variables that impact concentration (e.g., number of aircraft operations, duration of run-up operation mode, concentration of lead in avgas, wind direction, wind speed, temperature, and distance between the monitor and the run-up location). Specifically, the contractor collected and analyzed data that will serve as the input variables needed to quantitatively evaluate the factors that impact monitored lead concentrations at airports.

In this work assignment, the contractor shall use the data previously collected to carry out two types of analyses. These analyses shall include 1) univariate and multivariate equations, and 2) airport-specific air quality impact factors expressed as concentrations of lead in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) per operation.

Subtasks 1.1 and 1.2 describe how the contractor shall conduct both types of analysis. Subtask 1.3 describes the specific spreadsheets that the contractor shall provide to EPA as deliverables. Finally, Subtask 1.4 outlines parameters for a summary report on the work completed in the previous subtasks.

EPA will provide the following information for the contractor to conduct the work described in Task 1:

- 1) The list of airports that shall be the focus of the analysis in Task 1 (Table 1). The airports included in this analysis are those in the lead National Ambient Air Quality Standards (NAAQS) surveillance network that meet the following three criteria: i) the lead monitor was located immediately adjacent to or downwind from the maximum impact area¹, ii) on-site activity counts for piston-engine aircraft are available from WA 0-10 under EP-C-12-011 ("Recording Aircraft Operations at General Aviation Airports with Lead Monitors"),

¹ At airports these areas are located in closest proximity to the run-up and take-off location.

and iii) daily on-site aircraft activity traffic counts for General Aviation (GA) and Air Taxi (AT) operations are provided in FAA's Air Traffic Activity Database (ATADS).

- 2) An Excel file that contains individual worksheets for each airport listed in Table 1. Each worksheet contains the 24-hour monitored lead concentrations along with the corresponding GA and AT daily operations data that EPA has extracted from FAA's ATADS. The data are provided through the time periods noted immediately below. Details on monitor siting are also provided.
 - a. CRQ was monitored at the relevant location in ambient air downwind from piston aircraft operations from March 2012 through March 2013. Beginning in November 2014 data is being collected from a location distant from aircraft activity and therefore shall not be analyzed by the contractor for the purposes of this task.
 - b. MRI was monitored at the relevant location in ambient air downwind from piston aircraft operations from October 2011 through October 2012.
 - c. PAO was monitored at the relevant location in ambient air downwind from piston aircraft operations from February 2012 through December 2014. The monitor is being re-located, however the contractor shall not analyze data from the re-located site.
 - d. The RHV monitoring location has remained consistent throughout the sampling period and monitoring is currently ongoing; monitoring began in February 2012.
 - e. At SQL the relationship between lead concentration and activity shall be analyzed in two separate periods: a) for the first period from March 20, 2012 through May 28, 2013 co-located monitors were adjacent to aircraft conducting their run-up pre-flight checks, b) for the second period from June 3, 2013 through September 13, 2013 the run-up location was moved approximately 60 meters upwind from the monitoring location.
 - f. At VNY the relationship between lead concentration and activity shall be analyzed in two separate periods: a) for the period from November 5, 2011 through June 3, 2013 when the lead monitor was adjacent to aircraft conducting their run-up pre-flight checks on runway 16L, and b) for the period from January 2, 2010 through October 30, 2011 when the lead monitor was approximately 70 meters north of the other monitor location. Monitoring at this airport ceased on June 3, 2013.
- 3) All available fuel lead concentration data collected at the airports are listed in Table 1 (average of 2.14 grams lead per gallon). These data are not available for 4 of the 6 listed airports. For airports lacking fuel lead concentration data, the contractor shall use the maximum lead concentration specified by ASTM for 100LL of 2.12 grams per gallon. For the two airports with avgas fuel concentration data, the contractor shall use the airport average of the collected samples (i.e., 2.11 g/gal at PAO and 2.16 g/gal at RHV).

Table 1. Airports that are the Focus for Analysis in Task 2

Airport Name	City, State	AQS Monitor Number	Runway End Proximate to the Lead Monitor	Avgas Pb Concentrations (g/gal)
McClellan-Palomar (CRQ)	Carlsbad, CA	06-073-1020-1	24	-
Merrill Field (MRI)	Anchorage, AK	02-020-0051-1	25	-
Palo Alto (PAO)	Palo Alto, CA	06-085-2010-3	31	Rossi Aircraft: 2.02 Palo Alto Fuel Service: 2.19
Reid-Hillview (RHV)	San Jose, CA	06-085-2011-3	31R	Nice Air: 2.13 Aerodynamic Aviation: 2.21 San Jose Air: 2.14
San Carlos (SQL)	San Carlos, CA	06-081-2002-3	30	-
Van Nuys (VNY)	Van Nuys, CA	06-037-1402-1	16L	-

Subtask Descriptions:

1.1 Develop multivariate and univariate regression equations

The contractor shall create airport-specific multivariate and univariate regression equations to evaluate the variation in lead concentrations explained by total piston aircraft activity. Since the fraction of piston activity does not vary by day (in the previous work assignment the contractor estimated the fraction of piston activity separately at each airport and then applied each airport's fraction to all of the days that were analyzed at that airport) but by airport, only total piston operations will be evaluated against lead concentration at each specific airport. In addition to activity, the contractor shall also evaluate the following airport-specific variables: wind speed (daily average speed and daily maximum speed for airport operating hours), temperature, and wind direction. The contractor shall also explore regression equations that include input data across all airports in Table 1. For the all-airport evaluation the contractor shall include the variables used in airport-specific regressions as well as the following variables: a) average lead concentration in avgas, b) average run-up time, c) distance from run-up area to ambient monitor, d) %single-engine full LTOs, e) %single-engine T&Gs, f) %multi-engine full LTOs, and g) %multi-engine T&Gs. Where appropriate, the contractor shall consider interaction terms.

The contractor shall report the regression equations in airport-specific tables and plots of each relationship in the summary report (subtask 1.4). The variables that explain the majority of variation in lead concentrations shall be identified and the relevant equations that include these variables shall be noted for each airport. In addition, to help EPA understand the relationship between variation in lead concentrations and total piston aircraft activity, the contractor shall develop tables and figures of each airport-specific diurnal profile based on data collected under WA 3-11 under EP-C-12-011 (these diurnal profiles tables shall be similar to Table 4-2 in "Final Report: Modeling Analysis of Air Concentrations of Lead from Piston-engine Aircraft", developed under WA 2-11, EP-C-12-011).

The contractor shall also report in a table the various regression equations evaluated across all of the airports, which include the all-airport variables noted above. Figures of the relationships across all-airports shall also be included in the summary report.

The airport-specific tables and the table of evaluations across all 6 airports shall be provided in an Excel file, specified in subtask 1.3.4, as well as in the summary report (subtask 1.4). If the diurnal profile tables are available prior to other tables and figures, then the contractor shall provide these data to EPA in draft form ahead of delivery of subtask 1.3.4 and the summary report. Additional details on tables and figures that shall be included in the summary report are included in subtask 1.4.

1.2 *Calculate airport-specific air quality impact factors*

Daily air quality factors for each monitored day shall be calculated at each airport in Table 1 as the concentration of lead monitored divided by the total full cycle piston operations (sum of piston activity from single- and multi-engine aircraft) at the runway end listed in Table 1; the total activity data was derived in Subtask 1.3.3 of WA 3-11. Daily air quality factors shall also be calculated that use total full cycle piston operations *plus* T&G piston operations (from single- and multi-engine aircraft) as the denominator (derived in Subtask 1.3.3 of WA 3-11) and concentration of lead as the numerator.

For each airport, the contractor shall report basic statistics (i.e., average, minimum, and maximum) of the 24-hour air quality impact factors expressed as the concentration of lead per operation. These statistics shall be included in an Excel file, specified in subtask 1.3.5, as well as in the summary report (Subtask 1.4). Each of the 24-hr individual airport air quality impact factors shall also be included in this Excel spreadsheet.

In addition, where possible, the contractor shall calculate 3-month average air quality factors by dividing the 3-month average lead concentration by the sum of 3-month piston LTOs (sum of single- and multi-engine aircraft) that were conducted on the runway end listed in Table 1 for each 3-month period of monitoring².

1.3 *Develop summary spreadsheets*

The contractor shall develop and provide EPA with a series of data spreadsheets. In each spreadsheet the contractor shall clearly identify when data are missing or unclear from the original source. All spreadsheets shall also include appropriate meta-data (e.g., original data source, date of access, etc.):

1.3.1 *Primary Analysis Spreadsheet*

Each airport in Table 1 shall be in a separate tab/worksheet within the spreadsheet workbook. The rows in each tab/worksheet shall be the days that monitoring was conducted at that airport. The columns in the table are listed below; subtask numbers from WA 3-11 under EP-C-12-011 ("Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet") under which the variables were constructed are listed in parentheses after each variable description:

- Date (EPA Provided)
- Monitored 24-hr Lead Concentration (EPA Provided)

² 3-month AQFs shall only be conducted at airports with sufficient data – a month must have $\geq 75\%$ completeness in a month for that month to be valid to include in a 3-month average. All 3 consecutive months in a 3-month average must have $\geq 75\%$ of valid samples.

- ATADS Total GA Operations (EPA Provided)
- ATADS Total AT Operations (EPA Provided)
- Total # Single-Engine Piston Full Ops (task 2.1.1)
- Total # Multi-Engine Piston Full Ops (task 2.1.1)
- Total # Single-Engine Piston T&G Ops (task 2.1.1)
- Total # Multi-Engine Piston T&G Ops (task 2.1.1)
- Total # Single-Engine Piston Full Ops at monitored runway (task 2.3.3)
- Total # Multi-Engine Piston Full Ops at monitored runway (task 2.3.3)
- Total # Single-Engine Piston T&G Ops at monitored runway (task 2.3.3)
- Total # Multi-Engine Piston T&G Ops at monitored runway (task 2.3.3)
- Open Hours Avg. Wind speed (task 2.2.3)
- Open Hours Min. Wind speed (task 2.2.3)
- Open Hours Max. Wind speed (task 2.2.3)
- Open Hours Avg. Temperature (task 2.2.4)

1.3.2 *Meteorology Spreadsheet*

The data collected under subtask 1.2.1 in WA 3-11 under EP-C-12-011 ("Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet") shall be provided to EPA in a spreadsheet; each airport in Table 1 shall be in a separate tab/worksheet within the spreadsheet workbook. The rows of the table shall be each hour during the 24-hours of all air lead monitoring. The columns in the table are listed below:

Hourly Wind Speed
Hourly Wind Direction
Hourly Temperature

1.3.3 *Airport-specific hourly profiles*

The contractor shall provide EPA with tables of hourly profiles for each airport in Table 1 as calculated in subtask 1.3.1 in WA 3-11 under EP-C-12-011 ("Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet"). Profiles shall be provided for each aircraft type and mode.

1.3.4 *Regression Equation Results*

Regression results obtained under subtask 1.6 of this work assignment shall be provided to EPA in a spreadsheet. The contractor shall determine the optimal organization of the spreadsheet.

1.3.5 *Air Quality Factor Results*

Air quality factor summary statistics (i.e., average, minimum, and maximum) of the 24-hour and 3-month average air quality impact factors (expressed as the concentration of lead per operation) for each airport in Table 1 shall be provided to EPA in a spreadsheet. Additionally, each of the 24-hr and 3-month average individual airport air quality impact factors shall also be included in this Excel spreadsheet, where each airport's data is located in a separate tab/worksheet.

1.4 *Develop summary report*

The contractor shall prepare a final report that fully describes all methods and results from Task 1 of this work assignment as well as from Task 1 in WA 3-11 under EP-C-12-011 ("Analysis of Ambient Air Lead Concentrations Monitored Near Airports in the Lead

Surveillance Network, Collection of Meteorological Data, and Analysis of Nationwide Aircraft Fleet"). The report is intended for the general public and staff in other agencies, and thus shall be written to clearly and concisely convey the data, analysis and conclusions to a general audience with varying technical backgrounds. As appropriate, the contractor shall incorporate figures and tables that facilitate quick understanding of the report contents. In addition, it is expected that staff members developing the document played an active role in the data analysis detailed in the previous subtasks, and thus are well versed in the content of the document. Sections 1.4.1 – 1.4.3 below detail the approach for developing the report.

1.4.1 Develop report outline

The contractor shall develop an outline of the report that proposes, at a high-level, the structure and general contents of the report. The outline shall include a list of proposed figures and tables, the content of each table or figure, and the location of each within the outline. At a minimum, the report outline shall list the following figures and tables:

- Figures:
 - Total Piston LTOs at ambient monitor end versus average daily lead concentration at the monitored runway end
 - Diurnal profiles for each airport
- Tables:
 - Summary table of upwind and downwind lead concentrations at each airport.
To develop this table, the contractor shall determine the concentration of lead from when the monitor was upwind or downwind of aircraft take-off by the percentage of time that wind direction dictated the monitor as upwind or downwind (based on data collected in Task 1.2.2 in WA 3-11). Specifically, the number hours during each day when the monitor was "upwind" and "downwind" from aircraft activity shall be summed, separately. The sums of "upwind" and "downwind" hours shall be divided by 24-hrs to create ratios of downwind and upwind for each day and the ratios shall be multiplied by that day's lead concentration to develop separate "upwind" and "downwind" ambient lead concentration estimates. The contractor shall consult with EPA for any additional direction necessary to develop this table.
 - Diurnal profiles tables for each airport (similar to Table 4-2 in "Final Report: Modeling Analysis of Air Concentrations of Lead from Piston-engine Aircraft, developed under WA 2-10, EP-C-12-011)

In addition, the contractor shall propose one or more figures to represent the impact of distance between run-up area and ambient monitor. The contractor shall provide the outline in MS Word 2013 for review and approval by the WA COR.

1.4.2 Develop draft report

The Contractor shall be responsible for developing a draft report that: (a) meets rigorous standards of scientific objectivity, logic, and clarity; (b) incorporates appropriate references to relevant government reports or scientific literature (by ongoing searching and evaluation of the relevant technical literature and other sources of pertinent information for possible incorporation in the report); and (c) avoids including excessive or insignificant details, balanced against the need to avoid omitting key points or information likely to be known to experts in the field. In preparing

the draft report, the contractor shall immediately contact the WA COR with any questions regarding the content, scope or direction of the report. The contractor shall provide the draft report to the WA COR for review in MS Word 2013 with appropriate formatting to facilitate easily moving through the document (e.g., figures and sections are linked to the table of contents).

1.4.3 Develop final report

The contractor shall revise the draft report to address EPA comments. In addition, it is expected that staff members revising the document played an active role in drafting the document, and accordingly, review of revisions to the document should require less effort than that required for production of the first draft.

Task 2: Comparison of the piston aircraft fleet active at Reid-Hillview airport with the national fleet

The contractor shall compare the types of aircraft used at the Reid-Hillview airport (RHV) with the national piston-engine fleet. Information on the fleet composition at RHV shall come from the analysis completed by the contractor as part of WA 4-01 ("Ambient Lead Concentrations from Piston-Engine Aircraft") under EPA Contract EP-C-06-094. The objective of this comparison is to understand the extent to which the fleet at RHV is representative of the national fleet.

To conduct this analysis, the contractor shall complete the following subtasks:

2.1 Analyze national fleet information

The national piston aircraft fleet information provided in the database developed in subtask 3.1 of WA 3-11 shall be analyzed and categorized to provide an output file that summarizes the number of piston-engine aircraft by manufacturer and engine type. The output file shall also include metadata, such as type of aircraft (e.g., fixed wing single, fixed wing multi, rotocraft, gyrocraft), type of engine (e.g., reciprocating, 2-stroke, 4-stroke, rotary, unknown), year manufactured, engine horsepower, number of engines, and number of seats. Specifically, the contractor shall provide seven tables:

1. Table with engine manufacturers as the rows and engine types as the columns.
2. Table with engine types as the rows and aircraft types as the columns.
3. The other five tables will have a row for each engine manufacturer and engine type and then a column for each aircraft type, year of airframe manufactured (grouped by decade), engine horsepower (grouped), number of engines, and number of seats, respectively.

2.2 Create RHV data file

The contractor shall create a parallel file using the data collected in WA 4-01 ("Ambient Lead Concentrations from Piston-Engine Aircraft") under EP-C-06-094. This file shall include the observed aircraft tail/fin ID number, observed aircraft manufacturer, observed engine types, and any additional data available from observations (e.g., engine horsepower). In addition, the contractor shall include columns for the same data obtained by cross-referencing the RHV aircraft with national fleet data acquired in Task 3.1 of WA 3-11 (e.g., registry matched aircraft manufacturer, registry matched engine type). The contractor shall develop summary output files in Excel with same format as the summary tables created in Task 2.1 above.

2.3 Compare RHV and national fleet composition

To evaluate how representative the piston aircraft fleet at Reid-Hillview is of the national fleet, the contractor shall compare the data from RHV and the FAA national aircraft registry files created in subtasks 2.3 and 2.2, respectively. In this comparison, the contractor shall provide answers to the questions below in the form of a short report that

includes all data summary tables and figures needed to support the observations made. At the direction of the WA COR, the contractor shall also conduct the same type of comparisons between RHV data and data from individual states of interest for this work (e.g. AK).

Questions to be answered regarding the comparison of the fleet at RHV to the national fleet:

- a) How does the distribution of aircraft by manufacturer and engine type compare between the FAA national registry database and the RHV database? The answer shall be provided as a set of observations made when comparing these two fleets. The observations shall be based on comparisons of histograms or frequency distributions of aircraft type and engine type at a minimum.
- b) Was the most commonly or frequently observed aircraft at RHV also the most common aircraft registered in the FAA national registry database?
- c) Were there aircraft observed at RHV that are not common in the FAA national registry database?
- d) Which types of piston engine aircraft in the FAA national database were not observed at RHV and what percent of the national fleet do they compose?

2.4 *Report agriculture and pest control aircraft*

Separately, the contractor shall provide an Excel output file from the FAA registry database that includes the number of aircraft, by engine type, that are used in agriculture and pest control.

SCHEDULE OF DELIVERABLES

Task	Deliverable	Schedule (business days after work assignment start date)
N/A	Quality Assurance Project Plan	30
Task 1	Twice monthly meetings starting	7
	Report outline	7
	All data files listed in subtask 1.8	60
	Draft report	75
	Final report	100
Task 2	Draft report	30
	Final report	60

All deliverables shall be submitted electronically to the WA COR.

V. Other Requirements

All deliverables will be reviewed by EPA for conformance to the requirements of this Project before being approved as final. Final products shall be produced by the Contractor upon approval by the WA COR through written technical direction. The Contractor shall provide all materials written as part of these tasks to the WA COR, as per work assignment, in electronic format. Electronic versions shall be compatible with current EPA computer systems and software (e.g., Microsoft Word and Excel 2013).

VI. Special Conditions and Assumptions

Periodic meetings between the WA COR and contractor staff shall be necessary to discuss questions that may arise during performance or completion of this work assignment. At the WA COR's discretion, these meetings may occur via teleconference or video conferences. The Contractor shall document these meetings and submit copies of this documentation to the WA COR.

EPA United States Environmental Protection Agency Washington, DC 20460 Work Assignment						Work Assignment Number 4-22				
						<input type="checkbox"/> Other <input type="checkbox"/> Amendment Number:				
Contract Number EP-C-12-011			Contract Period 02/01/2012 To 09/30/2016 Base Option Period Number 4			Title of Work Assignment/SF Site Name Mass and Number Particle Loss				
Contractor ICF INCORPORATED, L.L.C.					Specify Section and paragraph of Contract SOW Task 6 Aircraft Analysis; Task 12 Tech support					
Purpose: <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Incremental Funding <input type="checkbox"/> Work Plan Approval						Period of Performance From 10/01/2015 To 09/30/2016				
Comments:										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund Accounting and Appropriations Data <input checked="" type="checkbox"/> Non-Superfund </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.										
SFO <input type="checkbox"/> (Max 2)										
Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:			LOE:					
02/01/2012 To 09/30/2016										
This Action:										
Total:										
Work Plan / Cost Estimate Approvals										
Contractor WP Dated:			Cost/Fee:			LOE:				
Cumulative Approved:			Cost/Fee:			LOE:				
Work Assignment Manager Name Bob Giannelli <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code:				
						Phone Number 734-214-4708				
						FAX Number:				
Project Officer Name Greg Janssen <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code:				
						Phone Number: 734-214-4285				
						FAX Number: 734-214-4821				
Other Agency Official Name <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code:				
						Phone Number:				
						FAX Number:				
Contracting Official Name Sandra Savage <div style="display: flex; justify-content: space-between;"> <div>_____ (Signature)</div> <div>_____ (Date)</div> </div>						Branch/Mail Code:				
						Phone Number: 513-487-2046				
						FAX Number:				

PERFORMANCE WORK STATEMENT

EPA Contract:	EP-C-12-011
Work Assignment (WA):	4-22
Issuing Office:	US Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) 2000 Traverwood Dr. Ann Arbor, Michigan 48105
Contractor:	ICF International 9300 Lee Highway Fairfax, VA 22031-1207
Statement of Work:	Mass and Number Particle Losses in an Aircraft PM Sampling System
Period of Performance:	October 1, 2015 – September 30, 2016
Work Assignment Contracting Officer Representative (WA COR):	Bob Giannelli 734-214-4708 giannelli.bob@epa.gov
Alternate WA COR:	Bryan Manning 734-214-4832 manning.bryan@epa.gov

This work assignment is a follow-on to complete work begun under Work Assignments 1-22, 2-22, and 3-22 of the subject contract, EP-C-12-011. This is a continuation of effort, the contractor shall not duplicate any work previously performed.

BACKGROUND

Measurement of particulate matter (PM) emissions from combustion engines is motivated by their detrimental health and welfare effects. PM emissions from combustion sources are chemically complex and, due to their size, have sampling train transport properties different than gaseous emissions and hence need careful consideration. When designing a sampling system for measuring PM emissions, a concern is the inherent sample losses that can take place in the sampling train during transport from the emissions source to the measurement instrument. These losses, due mostly to well understood physical phenomena, can lead to an underestimation of the amount of the actual PM emissions from the combustion source under consideration.

Under the request of the United Nations International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP), the Society of Automotive Engineers (SAE) has established a Standards Committee, named E31, which is developing a sampling system to measure PM emitted from turbo fan aircraft engines. The sampling train has been determined to require sample line lengths and sampling train configurations which lead to what are basically unavoidable sample losses that impact both size and mass measurement.

Estimates of the nonvolatile particulate matter (nvPM) mass percent loss in the sample train due to these physical phenomena are >30 percent. Particle number loss estimates are >40 percent.

These large losses lead to a reasonable concern over the accuracy of the measurement method. Hence, the E31 nvPM committee has developed a method by which the nvPM measurements can be adjusted for sample train losses based on estimated particle size distribution and penetration fractions.

This method has been reviewed internally by the E31 committee and by outside experts (EPA contract EP-C-12-011, Work Assignment 1-11). At this point, the line loss method needs to be documented for SAE and eventually for ICAO CAEP as part of a draft test procedure. Hence, the EPA requires assistance in documenting the sample train loss estimation method in a standard format acceptable to the SAE Committee and developing computer models to account and adjust for PM loss under the test procedure being developed.

TASKS

The purpose of this work assignment (WA) is to have experts on aircraft PM measurement assist in the preparation of a draft Aerospace Information Report (AIR) describing the PM loss estimation method and create computer models for PM loss.

Task 1: Provide technical expert for methodology documentation

The contractor shall identify at least one expert on physical and numerical modeling and aircraft engine emissions characterization, who is knowledgeable on measurement of nvPM emissions and analysis of PM loss in the PM measurement sample trains for both mass and particle number measurement. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not an all-inclusive or comprehensive list of subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

List of known technical experts:

- 1) Dr. Rick Mlake-Lye (Aerodyne Research, Billerica, MA)
- 2) Dr. David Kittleson (University of Minnesota, Minneapolis, MN)
- 3) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) DavidS. Liscinsky (United Technologies Research Center, East Hartford, CT)

Task 2: Attend E31 Loss Team Meetings

For the period of this work assignment (see below), the selected expert from Task 1 shall attend weekly E31 loss team teleconference meetings, communicate, and coordinate with loss team members on the loss correction methods. The approximate duration of these weekly meetings is one hour. Travel to meetings may also be necessary as part of this task.

Task 3: Methodology Development Documentation

The selected expert from Task 1 shall communicate and coordinate with loss team members on the loss correction methods. The selected expert shall prepare a draft AIR documenting the methods being developed by the SAE E31 to account and adjust for PM loss in the sample trains

for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31. Travel to meetings may be necessary as part of this task.

The AIR should follow the format prescribed by SAE (e.g., <http://www.sae.org/servlets/works/>). The SAE AIR 6241 may serve as an example of the format, but the contractor shall use his/her knowledge of the topic area and the draft materials prepared by E31 as the basis for identifying section and sub-sections topics.

Task 4: Provide technical expert for model development

The contractor shall identify at least one expert (different from the expert in Task 1) on modeling and aircraft engine nvPM emissions characterization. This expert shall have demonstrated experience with the measurement of nvPM emissions from aircraft engines and the development of PM loss particle penetration fraction models for PM measurement sample trains for both mass and particle number measurement from aircraft engines. The contractor shall consult with the EPA WA COR regarding the expert's qualifications before making a selection; EPA has provided a list of several known experts in the field. This is not an all-inclusive or comprehensive list of subject matter experts, and does not limit the contractor in finding and selecting the technical expert.

The EPA WA COR will acknowledge approval of the expert selected on aircraft PM measurement via written technical direction. The contractor shall not consult the EPA WA COR in the final determination of the expert selected.

List of known technical experts:

- 1) David S. Liscinsky (United Technologies Research Center, East Hartford, CT)
- 2) David Y.H. Pui (University of Minnesota, Minneapolis, MN)
- 3) Heidi Hollick (United Technologies Research Center, East Hartford, CT)
- 4) Dr. Max Zhang (Cornell University, Ithaca, NY)
- 5) Dr. Ahmad Khalek (Southwest Research Institute, San Antonio, TX)

Task 5: Develop PM Loss Models

The selected expert from Task 4 shall develop a PM loss model for the SAE E31 to account for and adjust for diffusion and thermophoretic PM losses in the sample trains for both the mass and number aircraft engine PM measurement under the test procedure being developed by E31. (See AIR 6241¹.) Travel to meetings may be necessary as part of this task.

TRAVEL

Communication with experts working on similar and related work to that contained in this work assignment is vital to ensure that the end products incorporate state-of-the-art knowledge. To the extent that such communication cannot reasonably be fulfilled via conference call, the contractor shall expect to travel in order to present, demonstrate, or observe findings related to the work contained in this work assignment. The contractor shall obtain prior approval from the contract-level COR for each instance of travel contemplated as a direct charge under this work assignment in accordance with clause H-22 of the contract. The contractor shall plan for one two week trip for 2 persons to Tullahoma, TN, and for one two day trip for 1 person to Minneapolis, MN.

¹ <http://www.sae.org/servlets/works/committeeHome.do?comtID=TEAE31>

DELIVERABLES

1. Quality Assurance Project Plan (QAPP).

The QAPP prepared under, and applicable to, WA 3-22 may continue to apply for this WA 4-22 if there are no changes based on the requirements of this work assignment or any other aspect of the WA 3-22 QAPP that has changed. Otherwise, the Contractor shall follow the procedures below.

The contractor shall submit a draft QAPP to the WA COR within 15 days of Work Plan approval. The QAPP shall detail data collection and analysis tasks and procedures for this work assignment. The WA COR shall review and comment on the draft QAPP. The contractor shall incorporate recommended changes and suggestions received from the WA COR and shall submit a final QAPP within 15 days after receipt of EPA comments. Guidance can be found at: QAPP for use of existing data: <http://www.epa.gov/quality/qs-docs/found-data-qapp-rqts.pdf>; Assessment Factors for relevance, applicability, utility of existing data: <http://www.epa.gov/spc/pdfs/assess2.pdf>; and EPA Requirements for QAPPs: <http://www.epa.gov/quality/qs-docs/r5-final.pdf>.

The final QAPP shall cover all aspects of this test program as outlined on the EPA quality website shown above. The QAPP shall have an appendix containing all applicable standard operating procedures (SOPs). The contractor shall adhere to all applicable SOPs and the QA procedures recommended therein. The contractor shall notify the WA COR immediately if they encounter any equipment failures that cannot be remedied, problems that may impact the quality or on-time receipt of deliverables, or unavailability of items required for this work assignment.

2. Weekly Progress Reports.

The contractor shall provide the EPA WA COR with brief weekly status reports via telephone conference or email during the period of performance. The progress report shall indicate the progress achieved in the concluded weeks, technical problems encountered, solutions to those problems, and projected activity for the upcoming weeks. Before proceeding with any solution to a problem, the contractor shall report the problem and consult with the EPA WA COR concerning the scope of the solution.

Schedule of Deliverables

Steps	Completion Date
Submit draft QAPP if needed	Within 15 days of Work Plan approval
Submit final QAPP	Within 15 days after receipt of EPA comments
Complete all tasks	September 30, 2016

NON-DISCLOSURE AGREEMENT

All documentation acquired and/or provided by EPA or generated as a result of this project shall be under the control of the U.S. EPA Assistant Administrator for Air and Radiation, or his or her designated representative, and shall not be released by the Contractor to any other source without specific approval by the U.S. EPA.